only discrepancy in this interpretation is the fact that Carus recorded *Cynthia rustica* (=*S. grossularia*) as well as *T. sylvani* from the Scilly Islands. Presumably the former term was restricted to the less crowded clusters in which the larvæ had not fixed themselves to the bodies of their parents.

WALTER GARSTANG.

PRINCIPLES OF BREEDING.

Principles of Breeding. A Treatise on Thremmatology. By E. Davenport, with appendix by H. L. Rietz. Pp. xiii+727. Country Life Education Series. (Boston, New York, Chicago, London: Ginn and Company, n.d.) Price 12*s.* 6*d.*

THIS is the first serious attempt to present a modern scientific text-book on the principles of breeding (or, as the author prefers to call it, thremmatology) to English-speaking agricultural students, in which recognition is accorded to much of the recent work done on genetics and some other branches of the physiology of the generative system, and in which effort is made to show the essential value of that work to breeders. The book is most welcome, and our thanks are due for it to the professor of thremmatology in the University of Illinois.

The author's idea of what is needful for the education of an agricultural student is very far in advance of what is usually considered sufficient for that purpose; his book is adapted not only to convey a much wider knowledge of scientific work than has been hitherto thought necessary, but to demonstrate the direct effect such work must have on the fortunes, the ultimate success, of the modern practical breeder.

In spite of the fact that Prof. Davenport declares the breeder of the future will be a book-keeper and statistician, his book shows he has a somewhat wider appreciation of the breeder's qualifications than these words indicate. At the same time, it does seem possible that his enthusiasm for the pure science of genetics has led him to load his book somewhat too heavily with figures, and to neglect to inculcate with sufficient force the necessity for a breeder's close attention to and intimate knowledge of the capacities and peculiarities of individual members of a flock or herd. This is, in our opinion, a serious defect in a text-book for agricultural students; the power of close observation is an essential qualification for a breeder.

Similarly, the author's endeavour to induce the student to take "short cuts" to success is to be deprecated. He urges "A man must realise the fruit of his own labours." "The breeder must therefore work faster than nature." The "evolutionary principle" must be accelerated; and so forth. In so far as it is possible to gain these ends his attempts to further them are good, but he omits to point out that at the best these ends can be only partially gained, and that the evolutionary principle cannot be accelerated sufficiently to *satisfy* individual aims. He notes that "experience shows that the purposes, standards, and methods of a successful breeder are seldom handed down from one man to another," but he does not attempt to point out the means whereby this can be obviated, and yet it is the most severe handicap to progress which breeders suffer from.

There is one great opportunity which all professors of a big agricultural college have to their hand, that of organising a system of records of the practical results subsequently gained by all the students which pass through their schools. Such records, compiled by men trained by modern scientific methods and made available for use at their college, would be of incalculable value, both to the professors and the breeders of future generations; in order to carry out such a scheme, however, the student must be taught to understand that there are no short cuts to knowledge, and that the only way they can hope to accelerate the acquisition of knowledge of evolutionary principles is by pooling their experiences, their failures as well as their successes.

Part i., on variation—the author makes variation rather than heredity the initial leading thought of his scheme, putting the cart before the horse and thereby somewhat confusing the issue—is a brief *résumé* of some of the leading features of that branch of the subject, instances being given of a kind specially suitable to stimulate the interest of American students, for whom the book is written.

Part ii., on the causes of variation and the relative stability of living matter, and part iii., on transmission, constitute the bulk of the book. The author's clear and forcible writing, the thoroughness of his treatment, the arrangement of his facts, and the wealth of illustration he gives are worthy of great praise. These sections are not only a valuable summary of what is known, but contain much original thought, and deserve the attention of all students of the subject.

Part iv. is on practical problems. Those dealt with under the headings selection, systems of breeding, plant breeding, and animal breeding are full of good common sense and sound advice; any breeder would do well to consult them.

Thus if it has failings the book has great merit, and it is to be hoped the example set by Prof. Davenport will be followed in this country, where the education of agricultural students in the science of breeding is sadly behindhand.

THERMOCHEMISTRY.

Thermochemistry. By Julius Thomsen; translated from the Danish by Katharine A. Burke. Pp. xv+495. (London: Longmans, Green and Co., 1908.) Price 9*s.*

OWING to the rapid strides which have recently been made in physical chemistry, the subject of thermochemistry, which is itself of a physical nature, has been rather left in the background. At one time it was hoped that thermochemistry would be of very great help in elucidating the hidden laws governing chemical reactions, but unfortunately it has hardly realised expectations.

Although a very large amount of work has been done upon this subject, we can hardly say that it has been found possible to rely upon thermochemical methods

to give us more than a general idea as to the course of reactions. At the same time, it is by no means a subject which can be dismissed as being useless, because a very great deal of help may at times be obtained by the study of thermochemical data. For example, in manufacturing operations, it is of the first importance to know heats of combustion, because the number of calories required to decompose a substance is of course a guide to the manufacturer in connection with the energy required in a given process.

Quite recently Prof. J. W. Richards contributed a very useful and interesting series of papers in an American technical journal upon the thermochemistry of metallurgical processes. Furthermore, the subject is of great importance to the electrochemist, who is able to determine the voltage necessary to be employed in an electrolytic process if he knows the heats of combination of the compound. Or we might take another example. In aluminothermics it is owing to the very high heat of formation of aluminium oxide that such an enormous amount of heat is given out when aluminium reacts with certain metallic oxides, and consequently one can tell beforehand whether a given oxide will be readily reduced by means of aluminium or not.

Of all the workers in the field of thermochemistry none has done such thorough, careful, and pioneering experimental work as Julius Thomsen, and it was a happy idea of Sir William Ramsay to include a translation of Thomsen's Dutch work in the well-known text-books on physical chemistry which are now finding such an important place in the chemical literature of the country; and we may say at once that Miss Burke has done her part of the work extremely well. As she states in the preface, it has been necessary at times, owing to the advance in other branches of physical chemistry, slightly to alter the reading of certain sentences; for example, taking her own illustration, where Thomsen has used the expression "Neutralisation is regarded as a union of acid and base, with formation of water," Miss Burke has changed this to "Neutralisation is regarded as a union of acid hydrogen and basic hydroxyl to form water." Undoubtedly some chemists will take exception to such an alteration, and will say it is pedantic and unnecessary, particularly those who are not attached to the ionic theory, and, after all, there are a goodly number who consider there are many difficulties which require to be cleared up before the ionic hypothesis can be considered fundamental.

The first portion, the introduction, introduces the subject with an explanation of experimental calorimetric methods, the apparatus being described and illustrated, and the methods of using it fully gone into. Chapter i. deals with the absorption of gases and the heat produced when they, liquids or solids are dissolved in water, and a number of tables are given, with the thermochemical data. The next chapter deals with the rather complicated question of heat of hydration; the methods of calculation for obtaining the heat formation of different compounds, provided the heat formation of certain substances is known, are carefully set out throughout the pages. The book not only deals with inorganic compounds, but also with a very large number of organic substances, the tables in chapter xii. being exceedingly full. An interesting part of this chapter is that in which the heat formation of isomeric compounds is given. Thus the difference of heat formation of propyl and isopropyl alcohol is 5·3 cal., that between isobutyl alcohol and trimethyl carbinol being 17·15 cal.

In fact, the book deals with Thomsen's work, and will undoubtedly be found extremely useful to any investigator who wishes to study this branch of the subject, and as a book of reference to be kept in all chemical libraries, though hardly, we think, for general reading, as it is rather too full for this purpose. F. M. P.

MATHEMATICAL TEXT-BOOKS.

(1) *The Elements of the Geometry of the Conic.* By Prof. G. H. Bryan, F.R.S., and R. H. Pinkerton. Pp. xi+270. (London: J. M. Dent and Co., 1907.) Price 3*s.* 6*d.*

(2) *Geometry, Theoretical and Practical.* By W. P. Workman and A. G. Cracknell. Part ii. Pp. ix+(330–535). (London: W. B. Clive, 1908.) Price 2*s.*

(3) *Practical Integration for the Use of Engineers, &c.* By A. S. Percival. Pp. vi+86. (London: Macmillan and Co., Ltd., 1907.) Price 2*s.* 6*d.* net.

(4) *Integration by Trigonometric and Imaginary Substitution.* By C. O. Gunther. Pp. vi+79. (London: A. Constable and Co., Ltd., 1907.) Price 5*s.* net.

(5) *A Course in Mathematics for Students of Engineering and Applied Science.* By F. S. Woods and F. H. Bailey. Vol. i., Algebraic Equations, Functions of one Variable, Analytic Geometry, Differential Calculus. Pp. xii+385. (Boston, New York, Chicago, London: Ginn and Co., n.d.) Price 10*s.* 6*d.*

(1) THIS is an attractive little book on geometrical conics. The argument is very clear, and presents the subject to a beginner in the simplest possible manner. The difficulty in writing a text-book of this sort lies in the fact that many properties of conics are far more easily treated by analytical than geometrical methods. The authors have met this difficulty by putting first those results which lend themselves more readily to geometrical proofs; other theorems are left until later on, and then the methods, if not the nomenclature, are analytical. A reasonably large number of examples is given, which are nearly all of a graphical or numerical nature. This is a pleasing innovation, and theoretical examples can be supplied by the teacher, if required, from almost any other text-book. A property of the parabola is discussed at the same time as the corresponding property of a central conic; much might be said both for and against this course. Many of the proofs are ingenious; the construction of the hyperbola by means of string and pins alone is worth noticing. A chapter is given in which are discussed those properties of the cycloid, catenary, &c., which can be proved without the aid of the calculus.